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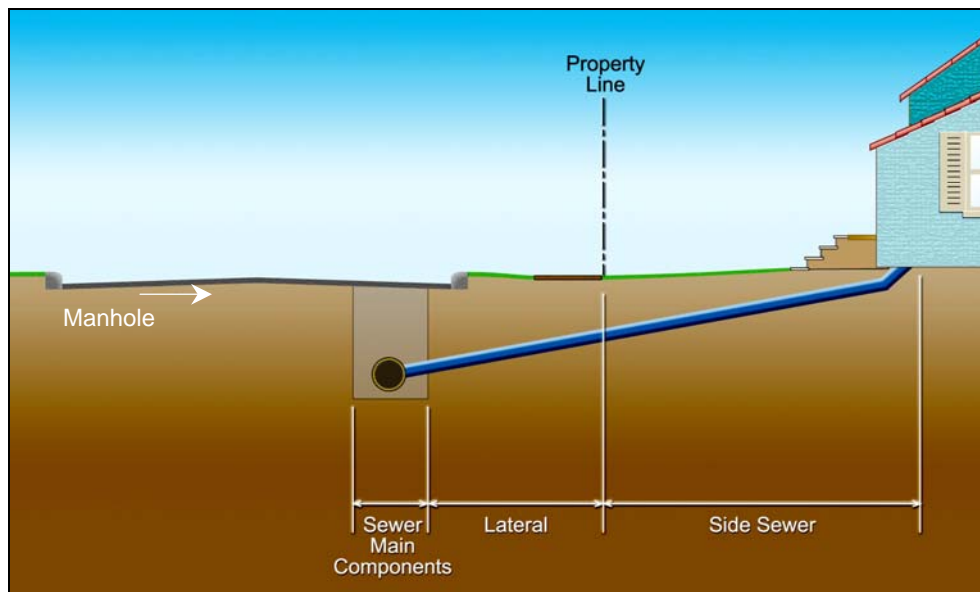


Figure 7-1. Sewer System Components



Smoke emanating from ground during smoke testing indicating cracks or defects in the buried side sewer.

Figure 7-2. Smoke Testing 1



Smoke emanating from ground during smoke testing.

Figure 7-3. Smoke Testing 2



Dye testing confirming down spout connected to ditch rather than sanitary sewer.

Figure 7-4. Dye Testing



Entire operation for installation of one section of sewer main CIPP.

Figure 7-5. Cured-in-Place Pipe 1



Scaffolding supporting water inversion equipment for installation of CIPP in sewer main. Boiler truck is in the background.

Figure 7-6. Cured-in-Place Pipe 2



Crew installing CIPP using the air inversion method.

Figure 7-7. Cured-in-Place Pipe 3



Steam exiting tail end of CIPP during the curing process.

Figure 7-8. Cured-in-Place Pipe 4



CIPP in bottom of channel. Liner was installed through this manhole and the portion of the liner above the spring line of the channel was removed after curing.

Figure 7-9. Cured-in-Place Pipe 5



Liner failed to fully inflate in this 12-inch-diameter sewer main at downstream manhole. Wrinkles extended several feet up the pipe and were not fully cured. Last run of pipe was re-pressurized and additional steam was applied. Short section of liner was then removed and a spot repair installed.

Figure 7-10. Cured-in-Place Pipe 6



A 4-foot section of blue liner wrapped around a packer in preparation for a CIPP spot repair. Blue resin is fast curing epoxy.

Figure 7-11. Cured-in-Place Pipe 7



Epoxy resin slug that pooled in a lateral connection to a sewer main during the installation of the CIPP in the sewer main. The slug is held adjacent to a sample pipe section with a lateral connection to illustrate the location of the slug in the field. The slug was removed during the reinstatement of the lateral connection.

Figure 7-12. Cured-in-Place Pipe 8



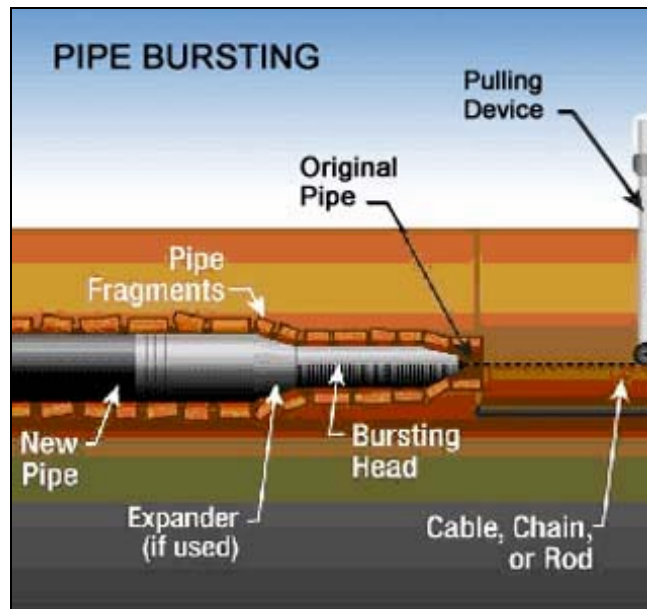
Epoxy resin slugs removed from laterals.

Figure 7-13. Cured-in-Place Pipe 9



Epoxy resin slug removed from laterals.

Figure 7-14. Cured-in-Place Pipe 10



Schematic of pipe bursting operation.

Figure 7-15. Pipe Bursting 1



Gray HDPE sections being welded into long lengths.

Figure 7-16. Pipe Bursting 2



Sections of welded HDPE ready to be dragged into position.

Figure 7-17. Pipe Bursting 3



Pipe bursting head attached to an 8-inch-diameter HDPE pipe. Note extra fins.

Figure 7-18. Pipe Bursting 4



Pipe bursting head being pulled into position to start the bursting operation.

Figure 7-19. Pipe Bursting 5



Small pipe bursting equipment consisting of a pair of 2-foot-long hydraulic cylinders and pressure plate. This equipment is capable of being used inside an existing manhole.

Figure 7-20. Pipe Bursting 6



Pipe bursting pressure plate and cable ready to begin pull.

Figure 7-21. Pipe Bursting 7



Trackhoe configured for pipe bursting. Note hydraulic motor, boom, and pressure plate.

Figure 7-22. Pipe Bursting 8



Trackhoe positioned at pulling pit during pipe bursting.

Figure 7-23. Pipe Bursting 9



Pipe bursting of a lateral. Pull was approximately 40 feet long.

Figure 7-24. Pipe Bursting 10



Manhole chimney in need of repair.

Figure 7-25. Manhole 1



Manhole with indications of settlement in the pavement that likely subject the cover to inundation during rainfall. The large number of pick holes in the lid also allows free flow of surface water into the manhole.

Figure 7-26. Manhole 2



Fiberglass manhole liner prior to wet-out.

Figure 7-27. Manhole 3



Layering of fiberglass manhole liner prior to wet-out.

Figure 7-28. Manhole 4



Fiberglass manhole liner being wet-out in the field.

Figure 7-29. Manhole 5



Fiberglass manhole liner being lowered into manhole.

Figure 7-30. Manhole 6



Note the manifold is still attached and the manhole is being ventilated.

Figure 7-31. Manhole 7



Fiberglass liner before trimming.

Figure 7-32. Manhole 8



Fiberglass manhole liner trimmed at the manhole ring.

Figure 7-33. Manhole 9



Leak in a cured fiberglass manhole liner.

Figure 7-34. Manhole 10



Manhole that has been raised slightly above grade to prevent surface inundation.

Figure 7-35. Manhole 11



Equipment for spraying cementitious grout on the inside surfaces of a manhole.

Figure 7-36. Manhole 12



Sprayed-on cementitious grout that has been smoothed with a trowel.

Figure 7-37. Manhole 13



Manhole lid below grade and subject to inundation from surface water running off the roadway.

Figure 7-38. Manhole 14



Manhole pan in place. Lid will fit back in place on frame.

Figure 7-39. Manhole 15



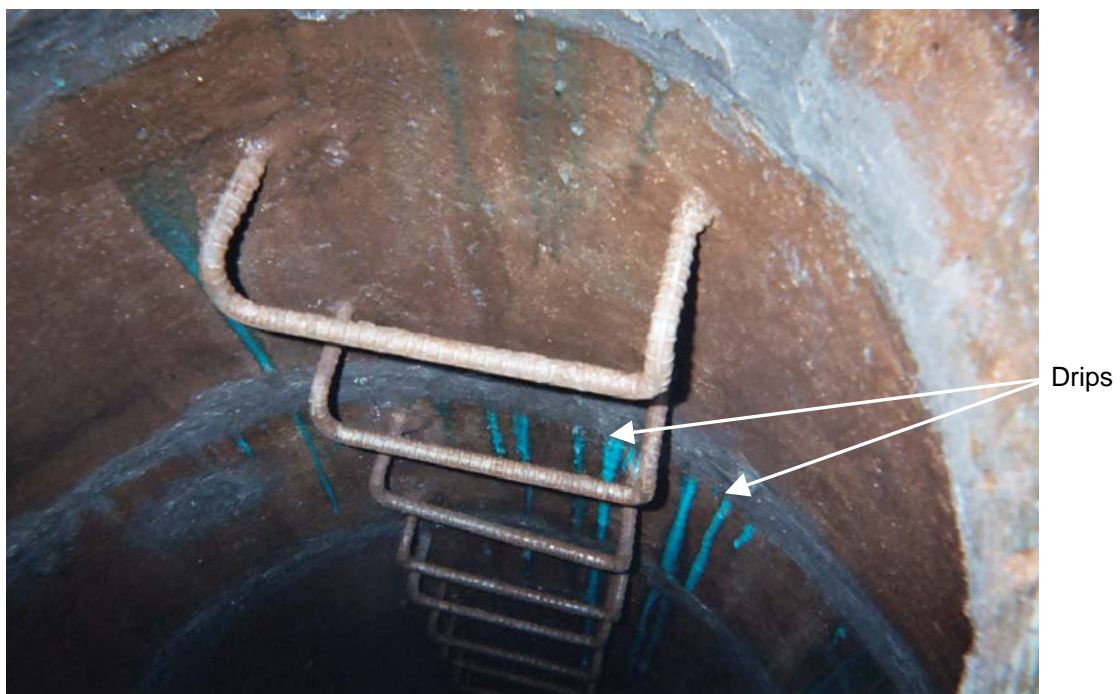
Other available manhole pans. Note: pan will not allow locking lid to be installed.

Figure 7-40. Manhole 16



Chemical grouting operation for manholes.

Figure 7-41. Manhole 17



Drips are chemical grout leaking back into manhole through defects.

Figure 7-42. Manhole 18



WHIRLyGIG tool assembled.

Figure 7-43. Manhole 19



Manhole with lid, frame, and leveling rings removed; ready for WHIRLyGIG installation.

Figure 7-44. Manhole 20



Plastic concrete form in place and being trimmed by the WHIRLyGIG tool.

Figure 7-45. Manhole 21



Frame in position on top of plastic concrete form.

Figure 7-46. Manhole 22



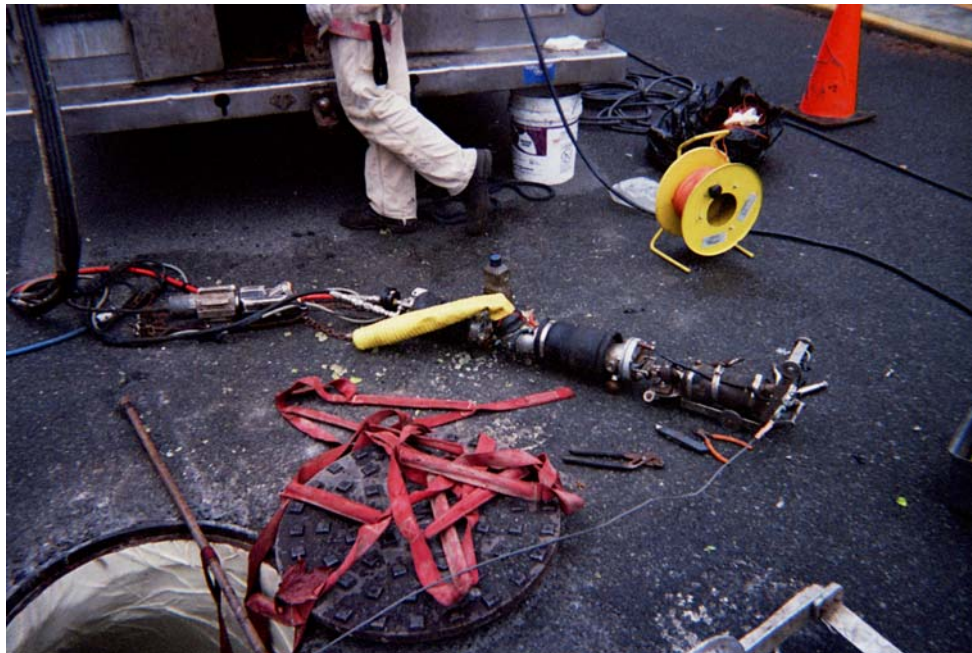
Concrete being poured to create solid concrete collar.

Figure 7-47. Manhole 23



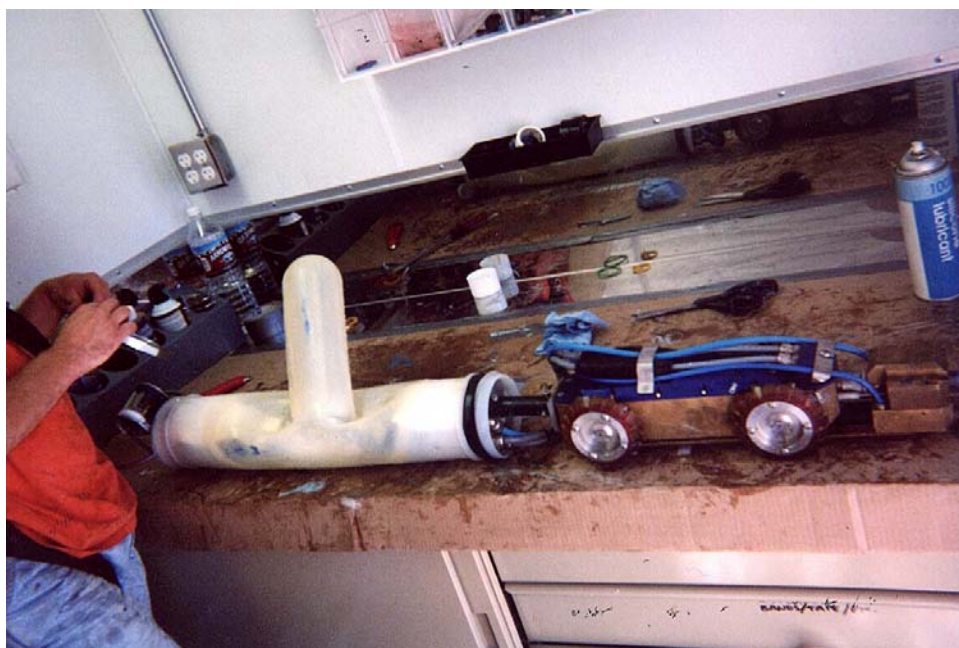
Completed concrete collar. Steel plate is required to protect fresh concrete and must be blocked up to avoid touching concrete. This may preclude allowing cars to drive over the plate.

Figure 7-48. Manhole 24



Specialty packer for chemical grouting the connection between a lateral and sewer main. Yellow packer will inflate inside the lateral.

Figure 7-49. Lateral and Side Sewer 1



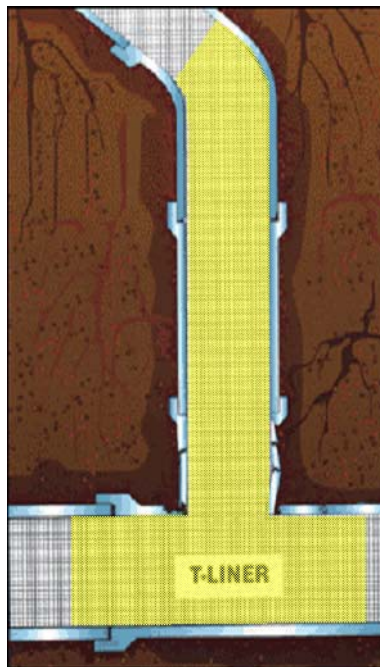
TOP HAT™ packer. Wheeled robot moves packer into position. White bladder will place TOP HAT™ into position. Bladder contains ultraviolet (UV) lights and a closed circuit television (CCTV) camera.

Figure 7-50. Lateral and Side Sewer 2



TOP HAT™ packer with TOP HAT™ in position. Blue paste is epoxy that will seal TOP HAT™ to service connection.

Figure 7-51. Lateral and Side Sewer 3



Schematic of a T-Liner®.

Figure 7-52. Lateral and Side Sewer 4



T-Liner® installation equipment located at downstream manhole. Similar equipment is located at the upstream manhole as the liner is placed inside the sewer main.

Figure 7-53. Lateral and Side Sewer 5



Trailer for field wet-out of T-Liners®.

Figure 7-54. Lateral and Side Sewer 6



Large bypass pumping operation to allow construction of improvements in a section of sewer main.

Figure 7-55. Bypass Pumping System